Investigation of Polycyclic Aromatic Hydrocarbon Compounds (PAHs) on Flue Gas Desulfurization (FGD) By-product

Ping Sun. Presenter
Department of Civil and Environmental Engineering and Geodetic Science, The Ohio State University, 470 Hitchcock Hall, 2070 Neil Avenue, Columbus, OH, 43210 E-mail: sun.127@osu.edu; Telephone: (614) 292-7340; Fax: (614) 292-3780

Linda.K.Weavers co-author
Department of Civil and Environmental Engineering and Geodetic Science, The Ohio State University, 470 Hitchcock Hall, 2070 Neil Avenue, Columbus, OH, 43210 E-mail: weavers.1@osu.edu; Telephone: (614) 292-4061; Fax: (614) 292-3780

Danold.W.Golightly co-author
Department of Civil and Environmental Engineering and Geodetic Science, The Ohio State University, 470 Hitchcock Hall, 2070 Neil Avenue, Columbus, OH, 43210 E-mail:golightly.2@osu.edu; Telephone: (614) 292-7340; Fax: (614) 292-3780

Summary

Flue Gas Desulfurization (FGD) technology has been widely used throughout the world in an effort to reduce acid rain from sulfur oxide emissions in coal combustion. However, the application of this technique leads to over 20 million metric tons of FGD by-product generated in the United States, annually. Rather than dispose of FGD by-product as waste in landfills, efforts are underway to identify opportunities to reuse it. Prior to reuse, FGD by-product must be physically and chemically characterized to determine reuse options, for example, its mechanical strength and environmental impacts. Compared with inorganic components such as heavy metals on FGD by-product, organic components are expected to be present in lower concentrations and consequently are often neglected. However, they may also have an important impact on the environment. Therefore, research concerning variability, fate (i.e., will it leach into the environment), and minimization of organic components on FGD by-product is necessary.

A major source of polycyclic aromatic hydrocarbons (PAHs) in the environment is from fuel combustion processes, (i.e., coal burning). PAHs are classified as refractory compounds, thus they persist in the environment. In addition, many PAHs are carcinogenic or mutagenic. Therefore, PAHs are of both environmental and health concerns. In this study, we examined the organic components, particularly PAHs on FGD by-product generated at the McCracken Power Plant on The Ohio State University campus.

Samples of FGD by-product were collected from the power plant on a daily, weekly, and monthly basis and analyzed for their PAHs concentration. In addition, samples of coal and lime were collected in order to determine how raw material characteristics might influence FGD by-product properties. Organic components on FGD by-product were measured by extraction in methylene chloride using an automated soxhlet extractor and subsequently detected with GC-MS (gas chromatography-mass spectrometry) analysis. The resulting information was used to assess the nature and variability of organic compounds of FGD by-product over a number of different time intervals.

Several PAH compounds were identified in FGD by-product, including naphthalene, acenaphthene, acenaphthylene, and phenanthrene. Other organic compounds were also found in the FGD by-product, for example, biphenyl and a series of n-alkanes. Quantification data of PAHs showed that the concentrations of these PAHs are low, usually less than a few μg/kg. The variability of detected PAHs follows no obvious trend.

However, initial indications suggest that PAH concentrations correlate with the presence of unburned carbon in FGD by-product. Unburned carbon is currently separated from FGD by-product, in which the PAH concentrations will be measured to test this hypothesis. Because the analyses of coal and lime are not yet complete, the relationship between these raw materials and the FGD by-product has not been determined. In order to examine the fate of organic components in FGD by-products and evaluate the potential for reuse, TCLP (Toxicity Characteristic Leaching Procedure) tests for organic leachate will be carried out.